

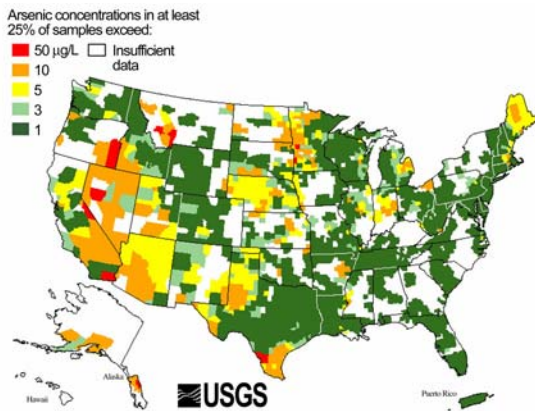
Arsenic Removal Using Amended Silicates™ : Opportunities Beyond the US



Author(s): Craig Turchi, Josh Gesick, John Lovell

Affiliation(s): ADA Technologies, Inc.

Problem Statement

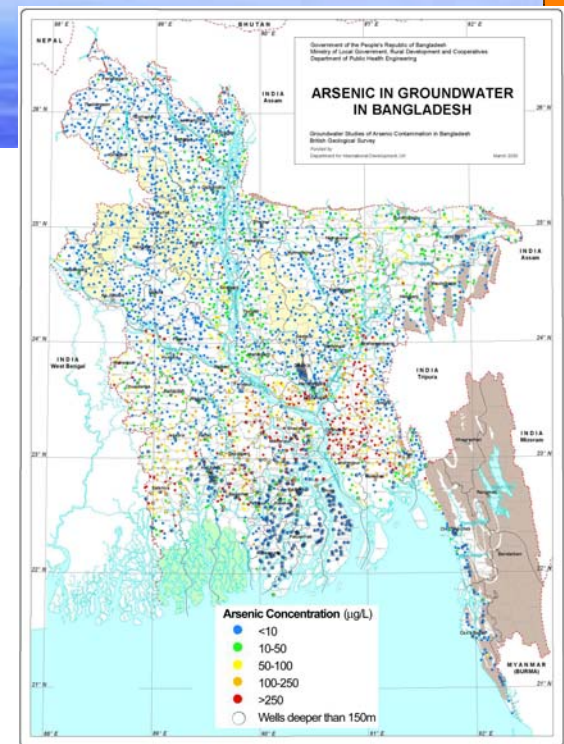


Arsenic is a naturally occurring groundwater contaminant that exists throughout the world. Groundwater containing arsenic generally looks and tastes clean, so users may not know they are ingesting a poison.

In the US, the Environmental Protection Agency lowered the maximum contaminant level for arsenic from 50 µg/L to 10 µg/L, effective January 2006. Small rural communities and other small users have struggled to meet the new standard.

In the developing world, groundwater arsenic concentrations can exceed the 10 µg/L value by an order of magnitude or more. This has led to severe arsenic poisoning in areas such as Bangladesh, India, and Nepal.

The solution for both situations requires a simple, effective, low-cost method of removing arsenic from water.



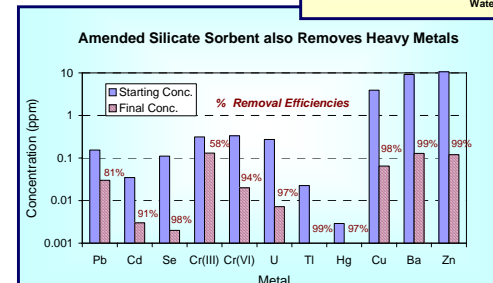
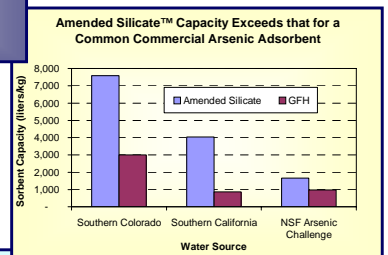
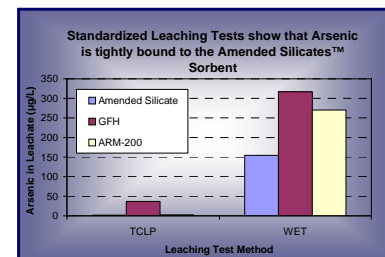
Amended Silicate™ Adsorbent

ADA's Amended Silicate™ sorbents are made by depositing nano-scale akaganeite (a form of iron oxide) onto an inert, inexpensive silicate substrate. The amendment process efficiently distributes the active ingredients, while the substrate provides physical shape and strength. Advantages include:

- Particle size can be determined by selection of substrate
- Very low bulky density, which allows for easy fluidization
- Arsenic capacity comparable to more expensive iron-based media
- Adsorb both As(III) and As(V) species; less sensitive to pH than alumina media
- No interference from sulfate, chloride, and other common water ions that interfere with ion-exchange systems

In addition to these general attributes, the sorbent is ideally suited for use in developing-world applications. For example:

- Simple manufacturing process from commodity chemicals means the material can be made locally with low-cost labor
- Low-bulk density and easy fluidization allow for simple contact methods that require little equipment or maintenance



Physical and chemical properties of ADA's Amended Silicates™ arsenic sorbent compared to commercially available iron-based media.				
Property	Amended Silicate™	USFilter GFH™	AdEdge AD33™	Engelhard ARM-200
Surface Area (BET)	80 m ² /g (ADA)	130 m ² /g (EPA)	140 m ² /g (EPA)	260 m ² /g (SNL)
Bulk Density	0.2-0.3 kg/L	1.2-1.3 kg/L	0.45-0.50 kg/L	0.45-0.50 kg/L
Particle Size	60 x 140 mesh	0.32 mm Effective size	10 x 35 mesh	12 x 40 mesh
Water Content	< 10%	40-50 %	< 15 %	< 10%
Iron Content	20-25 %	50-55 %	50-55 %	50-55%
Iron Phase	Nano-Scale Akaganeite	Akaganeite & Ferrhydrite	Goethite	Magnetite
Media Cost				
Cost (\$/ft ³)	47	238	245	?
Cost (\$/lb)	3	3.03	8.75	?

Simple Point-of-Use Treatment of Arsenic

In poor, rural areas of the developing world, extremely simple methods are needed to address arsenic-contaminated groundwater. ADA's Amended Silicate™ sorbent allows single-dose treatment of arsenic-laden water.



Step 1: Add contaminated groundwater to a cone-bottom vessel

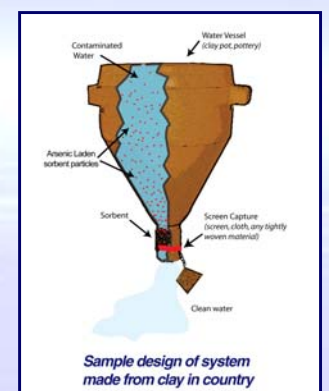
Step 2: Add a scoop of Amended Silicate™ sorbent



Step 3: Stir for approx. 10 minutes

Step 4: Allow sorbent to settle (approx. 10 minutes) Drain water out through the settled bed of Amended Silicate™ media. A piece of cloth holds the media in the vessel. The bed of media adsorbs arsenic and metal contaminants and removes turbidity.

The single-use method avoids bed plugging and guarantees fresh sorbent is available. No need to track bed life.



Acknowledgements

Environmental Protection Agency (EPA)
National Institute of Environmental Health Sciences (NIEHS)
Air Force Flight Test Center (Edwards Air Force Base, CA)
Kinetic Incorporated (Newbury, OH)
Dr. Des Cook - Advanced Metal Coating Analysis, Inc. (Virginia Beach, VA)
State of Colorado

